

## CSE 415 HW 4: Pen and Pencil Exercises (10 pts), due May 21 in class

1. (3 pts) Consider the following subgraph isomorphism problem. There are 2 directed graphs: F and G. We want to find a copy of F in G, using a tree search with forward checking.

Graph F is given by  $(V_F, E_F)$  where  $V_F = \{1,2,3,4,5\}$  and  $E_F = \{(1,3)(1,4)(2,1)(3,2)(4,3)(4,5)\}$

Graph G is given by  $(V_G, E_G)$  where  $V_G = \{A,B,C,D,E,F\}$  and  $E_G = \{(A,C)(A,D)(B,A)(C,B)(C,F)(D,C)(D,E)(F,E)\}$

The (usual) constraint for finding an isomorphic copy of digraph F in digraph G is that if there is an edge from node  $i$  to node  $j$  in F, there must be an edge from  $f(i)$  to  $f(j)$  in G, where  $f$  is the isomorphism.

a. First draw the 2 graphs F and G below.

F	1	2		G	A	B
	3	4			C	D
	5				E	F

b. Next, show parts of the tree search specified below to search for a consistent labeling using only forward checking and none of the other techniques or heuristics in Chapter 5.

Do this in the blind order that has variable 1 at level 1 in the tree, variable 2 at level 2, and so on down to variable 5 at level 5. Stop when you find a consistent labeling or learn that there is none on some branch. At each level, of the values that are still possible in the forward checking table (FTAB), try them in alphabetical order.

You will be doing only 2 subtrees of the search: the one under (1,A) and the one under (1,B). For every node that you process, show the assignment at that node (ie. 1,A) and (except at level 5) a forward checking table (FTAB) whose rows are for all the unassigned variables and whose columns each represent a possible value. Use 1's for values that are still OK and 0's for values that have been ruled out either by forward checking or the fact that the function must be an isomorphism.

Mark consistent labelings you find with a \* and dead ends with an X. (Use next 2 pages for your answer.)

(1,A)

A B C D E F

2

3

4

5

(1,B)

A B C D E F

2

3

4

5

2. (7 pts) Given the following facts, you want to prove the conjecture that John is the (horse) thief.

a. (3.5 pts) Convert each fact and the negation of the conjecture to a predicate logic expression:

1. Either John is the thief or Fitzroy is the thief.

2. If a person is the thief, then he entered the stable.

3. If a stranger entered the stable, then the dog barked.

4. Fitzroy is a stranger.

5. John is not a stranger.

6. The dog did not bark.

7. Negation of John is the thief.

b. (1 pts) Convert the logic expressions from a. to final clause form.

c. (2.5 pts) Construct a refutation graph that shows the resolution proof that John is the thief. It should end with the symbol NIL.